Biomechanical Comparison of 2 Anterior Cruciate Ligament Graft Preparation Techniques for Tibial Fixation: Letter to the Editor
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What is This?
Dear Editor:

We are sending this letter with regard to the article titled “Biomechanical Comparison of 2 Anterior Cruciate Ligament Graft Preparation Techniques for Tibial Fixation: Adjustable-Length Loop Cortical Button or Interference Screw” by Mayr et al. As devoted readers of *AJSM* and clinical scientists interested in innovative technology and techniques, we have concerns based on our own research on this topic relative to the authors’ method and therefore their conclusions.

Research on this topic existed prior to publication of the Mayr et al article. Our work was ultimately accepted by the peer-reviewed *Journal of Knee Surgery*, with online preview available as early as October 2014 prior to its print publication. Unfortunately, Mayr and colleagues did not reference our work several months after it was cited in PubMed, and the reality is their study is not the first published work on biomechanical testing of adjustable-length loop suspensory fixation for the tibia. Furthermore, a recent clinical outcomes study was presented during an American Orthopaedic Society for Sports Medicine (AOSSM) meeting, with excellent subjective and objective outcomes.

We believe that it is the duty of authors to provide the latest citations to ongoing works throughout the publication process, particularly as journals are becoming available online and technology rapidly advances. As we demand more from our technology, we should also demand more from ourselves.

In the Mayr et al study, a major methodological flaw relates to the lack of tensioning and preconditioning of the grafts prior to testing. In the clinical setting, the recommendation for the quadrupled tendon graft construct with adjustable-length loop suspensory fixation is to tension the graft for preparation at 20 lb (89 N) on the prep board, unlike the 20 N used in this study. This may have contributed to the significantly different cyclic displacements observed between the suspensory and interference screw group.

Another important limitation to note with the authors’ suspensory graft preparation is that they did not use the sutures that join the 2 free ends of the graft when initially creating the quadrupled graft construct. Clinically, these sutures are routinely used for additional fixation on the tibial side in addition to the tibial button itself; however, these sutures were cut in the Mayr et al study. This was a major difference compared with our study and could have contributed to the difference in ultimate load and cyclic displacement between our study and theirs. In our study, the average load to failure of tibial suspensory fixation of the all-inside continuous loop construct (1012 N) was statistically different compared with the interference screw group (612 N) (*P* < .001). Using the same protocol of cyclic loading between 50 and 250 N at a 1-Hz frequency that Mayr et al used, we found that the cyclic displacement of the continuous loop construct at 2.5 mm was not statistically different from the interference screw construct at 1.9 mm (*P* = .205). Similarly, stiffness was not significantly different at 165 N/mm for the GraftLink group and 193 N/mm for the interference group (*P* = .143).

An area of further research that was not fully addressed in either our study or the Mayr et al study is the ability to “condition” the graft in situ by retensioning femoral and tibial TightRopes. This is a key technique feature for a continuous loop construct, and theoretically, the first 2 phases of displacement during cycling reported by Mayr et al for the continuous loop samples would be reduced, as the TightRope could be retensioned in situ. This, of course, could not be done for an interference screw.

In summary, we believe that biomechanical studies that are published in clinical journals should present clinically relevant and applicable testing parameters that match surgical technique. If this is not the possible, these publications may be more appropriate for engineering-focused journals. Providing a “clinical relevance” conclusion is otherwise misleading when clinical application was not followed.

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Biomechanical Comparison of 2 Anterior Cruciate Ligament Graft Preparation Techniques for Tibial Fixation: Response

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Authors’ Response:

We are most grateful for the comments made on our paper “Biomechanical Comparison of 2 Anterior Cruciate Ligament Graft Preparation Techniques for Tibial Fixation: Adjustable-Length Loop Cortical Button or Interference Screw.” Of course we agree that scientific papers should cite and discuss the most recent publications. Our manuscript was submitted in August 2014, and at that time neither the paper by Smith and DeBerardino6 nor the abstract on clinical application presented by Nawabi et al5 at the American Orthopaedic Society for Sports Medicine (AOSSM) meeting was available online.

To the best of our knowledge, our paper is the first published study on biomechanical testing of an entire anterior cruciate ligament (ACL) construct consisting of a tendon graft with 2 adjustable-length loop cortical buttons, as implanted during surgery. The study setup that was used measures the elongation of the entire construct for ACL reconstruction, including slippage of the tendon strands as the graft is secured in a loop as well as the elongation caused by the femoral adjustable-length loop cortical button.

Smith and DeBerardino6 measured the graft displacement that occurs at the tibial intra-articular tunnel aperture during 500 load cycles, whereas in our study we measured the elongation of the entire ACL construct after 1000 load cycles. This might explain why, in our own study, the graft with tibial button fixation showed significantly greater elongation in comparison with the graft with screw fixation. In contrast to the data mentioned in their letter, Smith and DeBerardino6 reported a mean ultimate failure load of 662 ± 203 N for the graft with screw fixation, a figure that is comparable with our data (693 ± 119 N). They reported higher ultimate failure loads for the graft with tibial button fixation (1012 ± 102 N) in comparison with our results (908 ± 74 N). This might be due to the additional fixation of whipstitch sutures on the tibial button used by them. As mentioned, we did not use whipstitch suturing of the free ends for additional fixation on the tibial button. It was not described in the publication on the technique by Lubowitz,2 and according to the surgical technique recommended by the manufacturer at the time of the study, whipstitch sutures can either be cut off or used for additional fixation.1 In clinical practice, we also did not routinely apply additional fixation of whipstitch sutures on the tibial button, and we kept all technical parameters the same in order to test clinically relevant variables.

However, we agree that additional fixation of whipstitch sutures might slightly reduce graft elongation with tibial button fixation. In another study, we have shown that using an additional suspension improved the ultimate failure load but did not significantly reduce the total elongation of the graft.5

We are aware of the AOSSM abstract by Nawabi et al,5 published online in August 2014, as well as of the results on postoperative physical magnetic resonance imaging reported by Nawabi et al.4 ACL reconstruction using cortical buttons on both the femoral and the tibial sides represents an attractive technique in skeletally immature patients. However, Nawabi et al4,5 did not carry out a comparative study of different ACL reconstruction and graft fixation techniques.

Graft preconditioning at a load of 20 N was mentioned as a major methodological flaw in our study. It should be noted that the graft was preconditioned at 50 N for 5 minutes in a materials testing machine. This should be sufficient to eliminate initial slack in the tendons and sutures.

After graft implantation, initial graft elongation can be minimized by cycling the knee and by further shortening of the adjustable-length loop cortical buttons. As mentioned, we did not retension the graft using further shortening of the cortical button loops, either after preconditioning or after the first 5 load cycles. However, it should be noted that the graft with tibial screw fixation could also be retensioned via the adjustable-length loop cortical button on the femoral side. We agree that retensioning the grafts might reduce the first 2 phases of displacement occurring during cyclic loading (preconditioning and cycles 1–5), but since this is valid for both graft preparation and tibial fixation techniques, this should not compromise our findings.

Finally, the results of biomechanical studies always need to be translated cautiously into clinical performance and outcomes. Clinical studies are currently ongoing and, we hope, will bring more clarity to this topic.

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